Benthic Impacts – Clam Grazing

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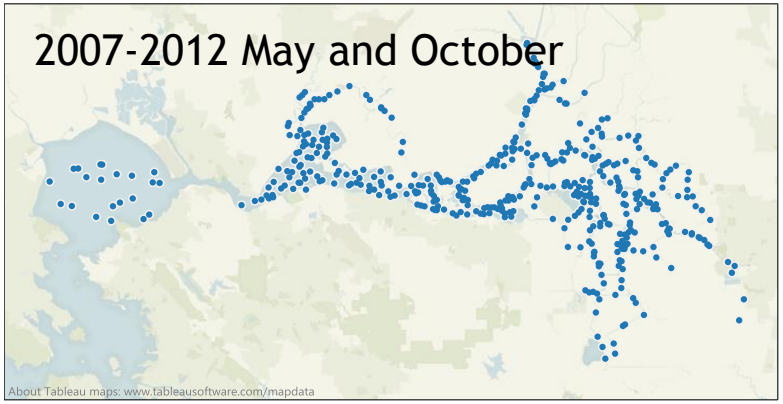
A collaborative study between CA Department of Water Resources and USGS using currently or previously collected benthic samples in four sampling programs. Funded by IEP, DWR/EMP, USBR, USGS, CALFED

Temporal Studies – DWR Monitoring

Map based on long and lat. Color shows details about Panel. The marks are labeled by SiteID. The data is filtered on class, which keeps CA and CF. The view is filtered on Panel, which keeps Monitor May 2010.

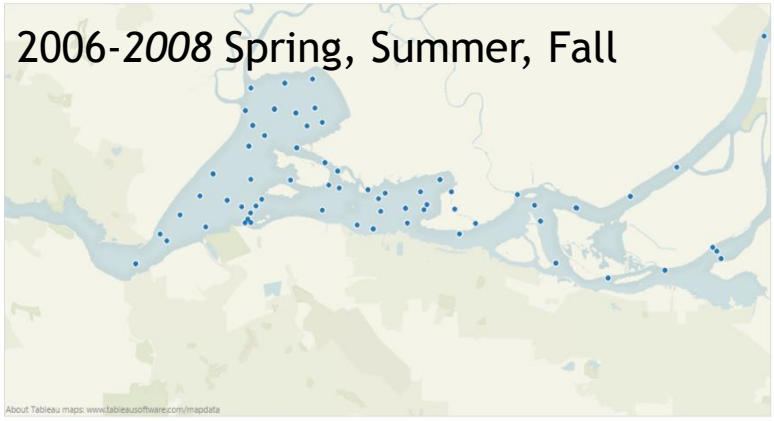
Spatial Studies – DWR GRTS



Map based on average of long and lat. The data is filtered on year, Panel and Strata. The year filter has multiple members selected. The Panel filte has multiple members selected. The Strata filter has multiple members selected

Spatial Studies – USGS/LSZ

Sheet 57



Map based on long and lat. The data is filtered on year, month and Agency. The year filter ranges from 2006 to 2008. The month filter keeps 10 of 10 members. The Agency filter keeps USGS and USGS-LSZ.

Temporal Studies – USGS

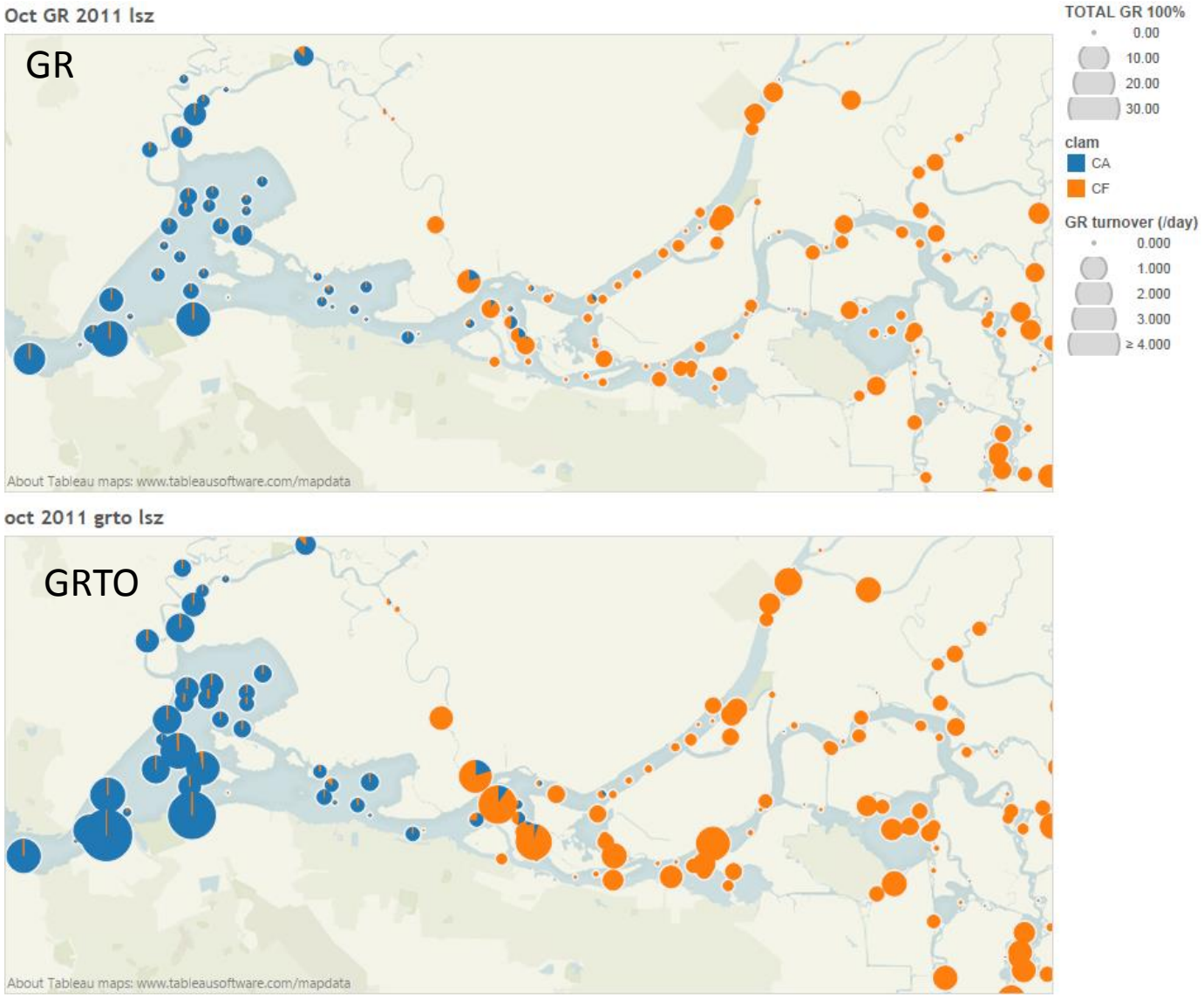
Sheet 57

Map based on long and lat. The marks are labeled by SiteID. The view is filtered on SiteID and Exclusions (lat,long). The SiteID filter keeps 8 of 1,698 members. The Exclusions (lat,long) filter keeps 1,354 members.

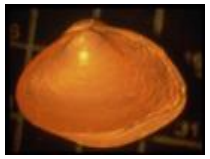
Terms -

- GR – grazing rate corrected for concentration boundary layer and temperature (m/d)
- GRTO – grazing rate turnover rate - GR normalized by depth (/d): GR/z : (m d^{-1}) m^{-1}= d^{-1}
- Data is combination of GR, GRTO, Biomass (is not affected by temperature like GR and can be converted to carbon), Recruit #
- Recruit abundance examined because it reflects “what is possible” in an environmentally different world.

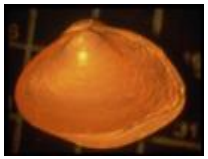
Grazing rate and grazing turnover rate do not give us a similar picture – GRTO is important in phytoplankton biomass



Important <u>similarities</u> in *Potamocorbula* and *Corbicula* characteristics that contribute to their response to restoration

Characteristics	*Potamocorbula*	*Corbicula*
	 =	
Exotic Introduction	1986	1940's
Opportunistic/Disturbance Affinity	Yes	Yes
Filter Feeder-phytoplankton	Yes	Yes
Food Limited	Yes	Yes
Filter Feeder-zooplankton	Yes	Yes
Fish Prey	Yes	Yes
Physical Habitat Range	Wide	Wide

Important differences in *Potamocorbula* and *Corbicula* characteristics that contribute to their response to restoration

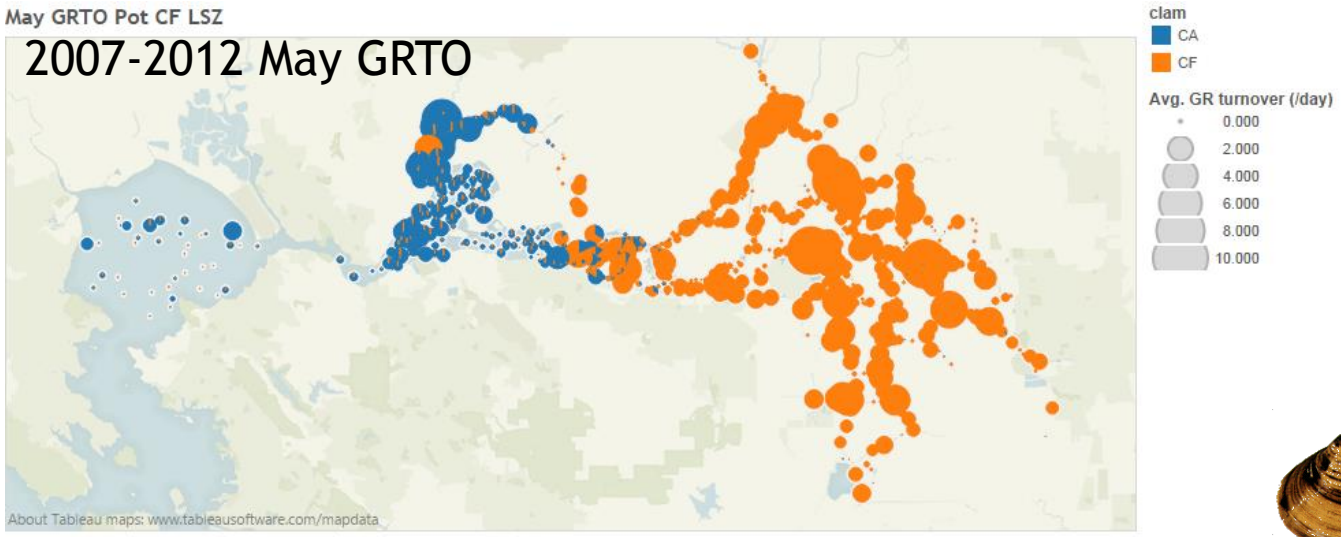
	Characteristics	*Potamocorbula*		*Corbicula*
			≠	
Distribution	Salinity Preference- juveniles	≥2		≤2
	Salinity Preference - adults	≥0		≤10
	Reproduction I	Dioecious		Hermaphrodite
	Reproduction II	2 + Spawn/yr		Many Brood/yr
	Larval Dispersion	Pelagic		Bedload
Function	Deposit Feeder	no		yes
	Life Span	2-3		3-5
	L Water filtered/10 g tissue (20°C)	4000		1000
	Prey for birds	Important		Minor
	Selenium Content	High		Medium*

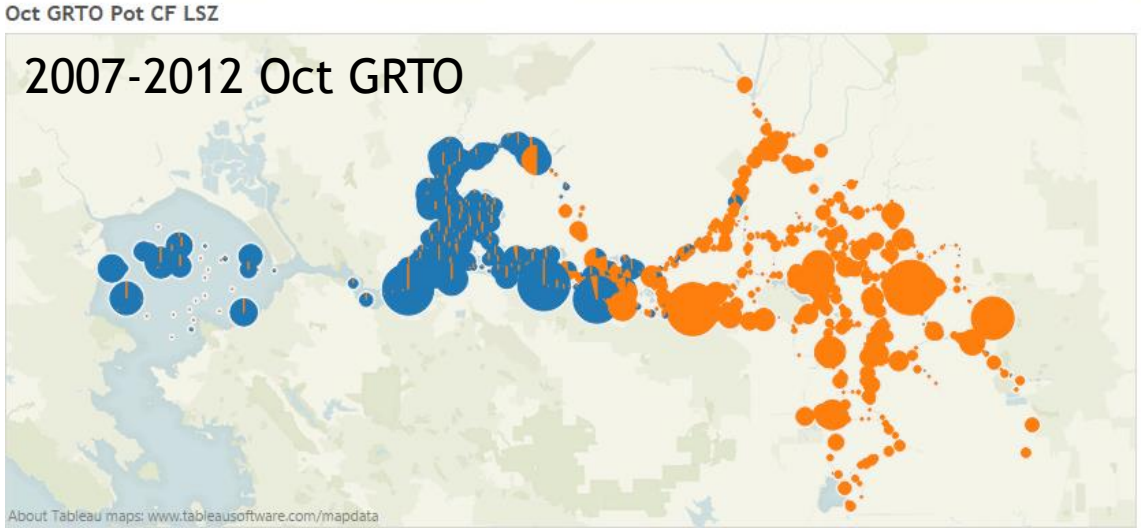
*function of size and predator preference

Imposing a little order

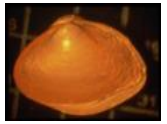
- Observation – in most cases the *Corbicula* data was not significantly different on the basis of year or habitat
- Mechanism – what factors control the observation
- Effect – what effect does this have on the food web
- Restoration Implication – Can we use this information?

Observation #1: Combined data shows the persistence of low *Potamocorbula* grazing in Grizzly, San Pablo, and Honker Bays in spring and the strong increase in grazing in October. Seasonal patterns harder to discern with *Corbicula*.



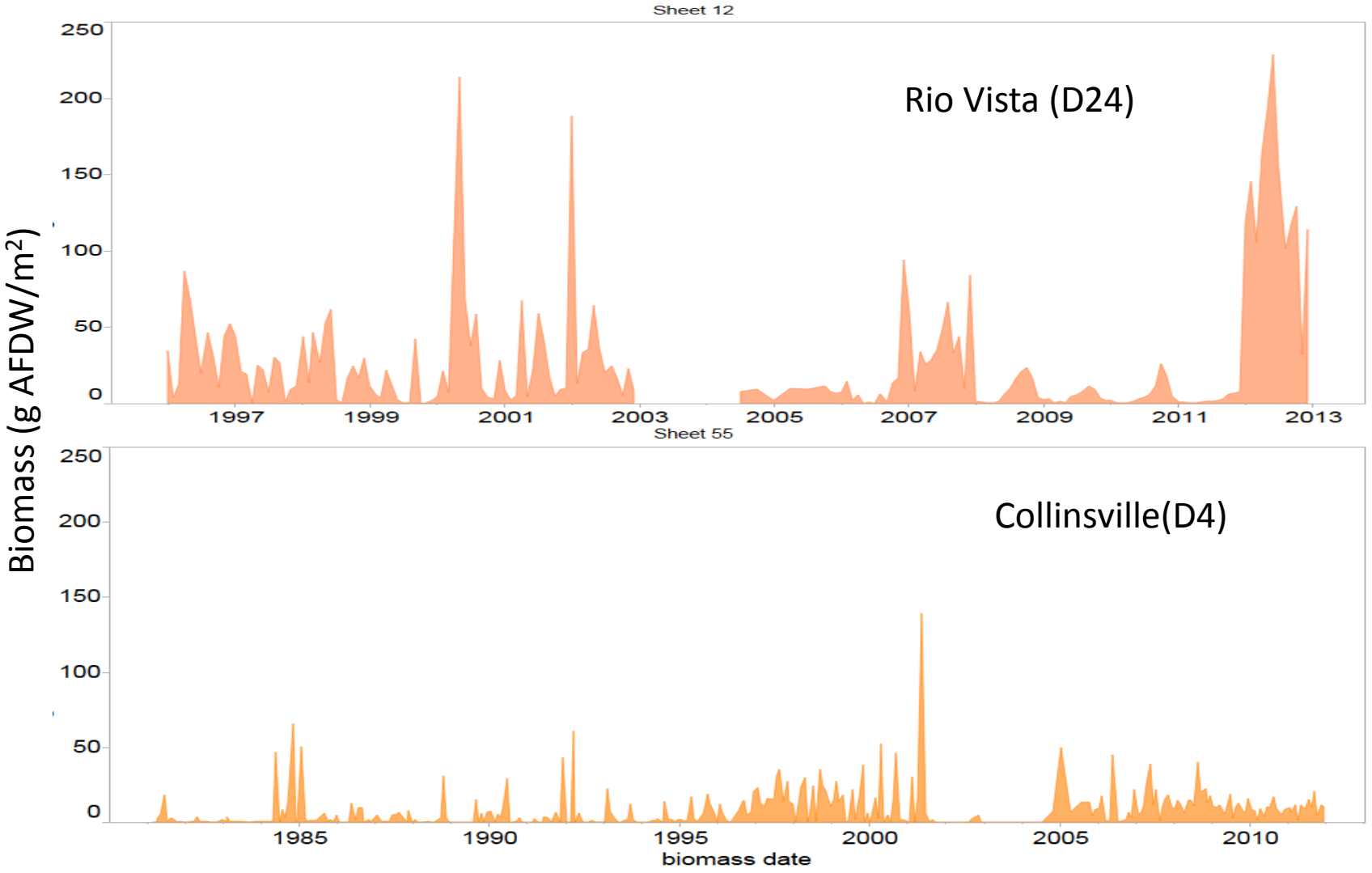


Corbicula

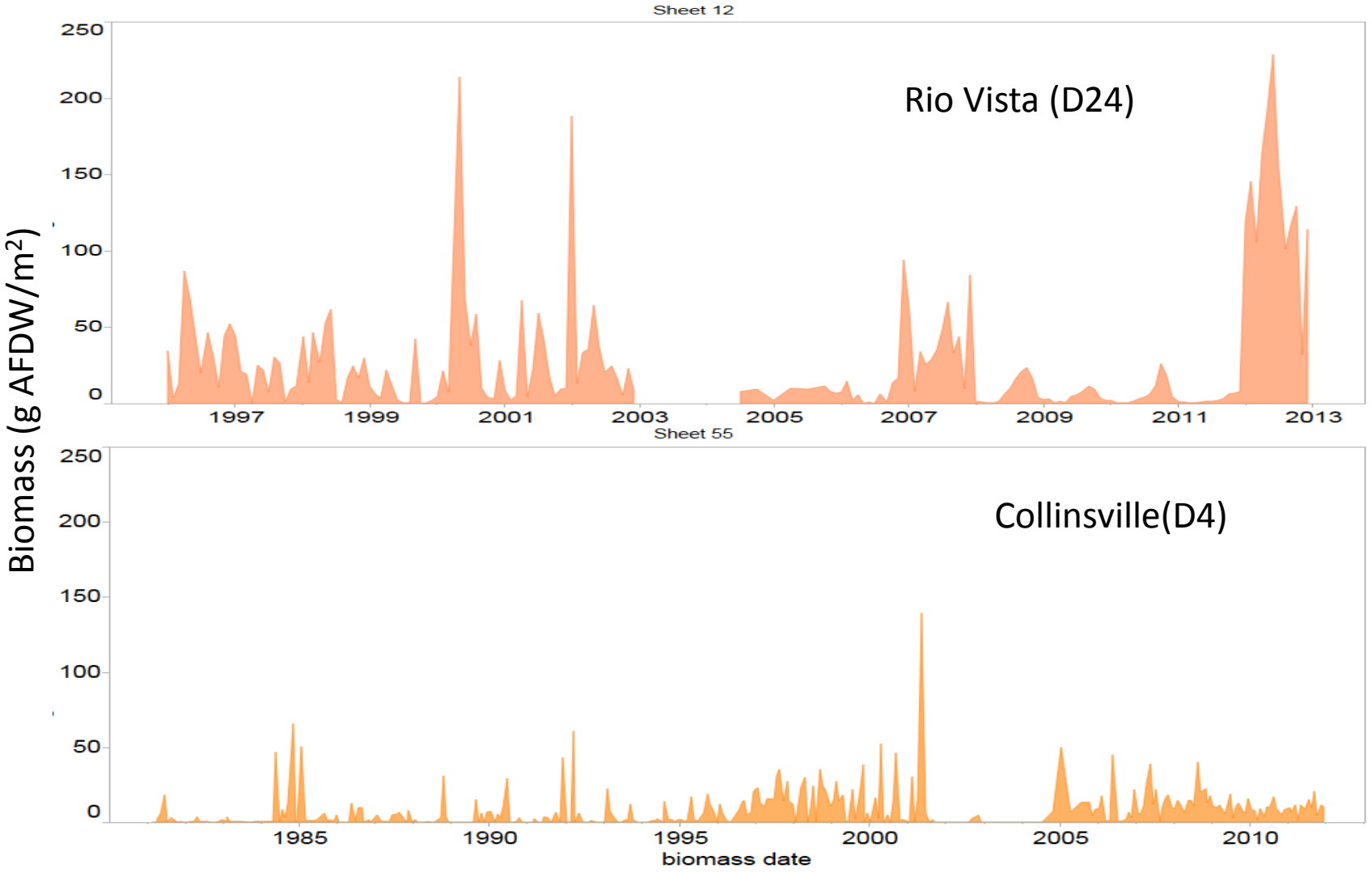


Potamocorbula

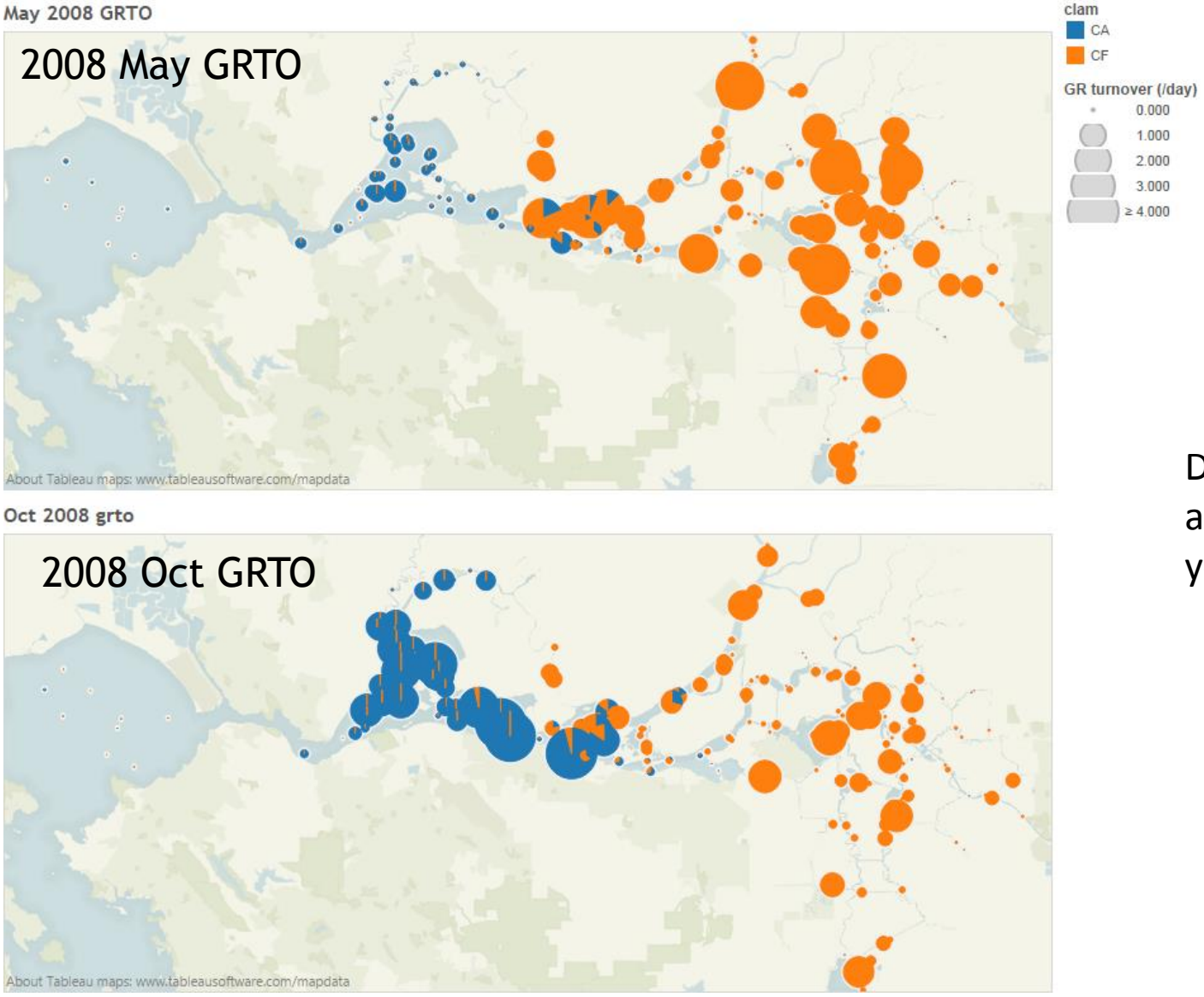
Mechanism: The lack of obvious differences in *Corbicula* biomass between May and October GRTS samples reflects its inherent variability. Some variation is due long lifespan but the most likely reason is opportunistic behavior in a population that is resource limited.



Effect: *Corbicula* may always be prepared to take advantage of new conditions.

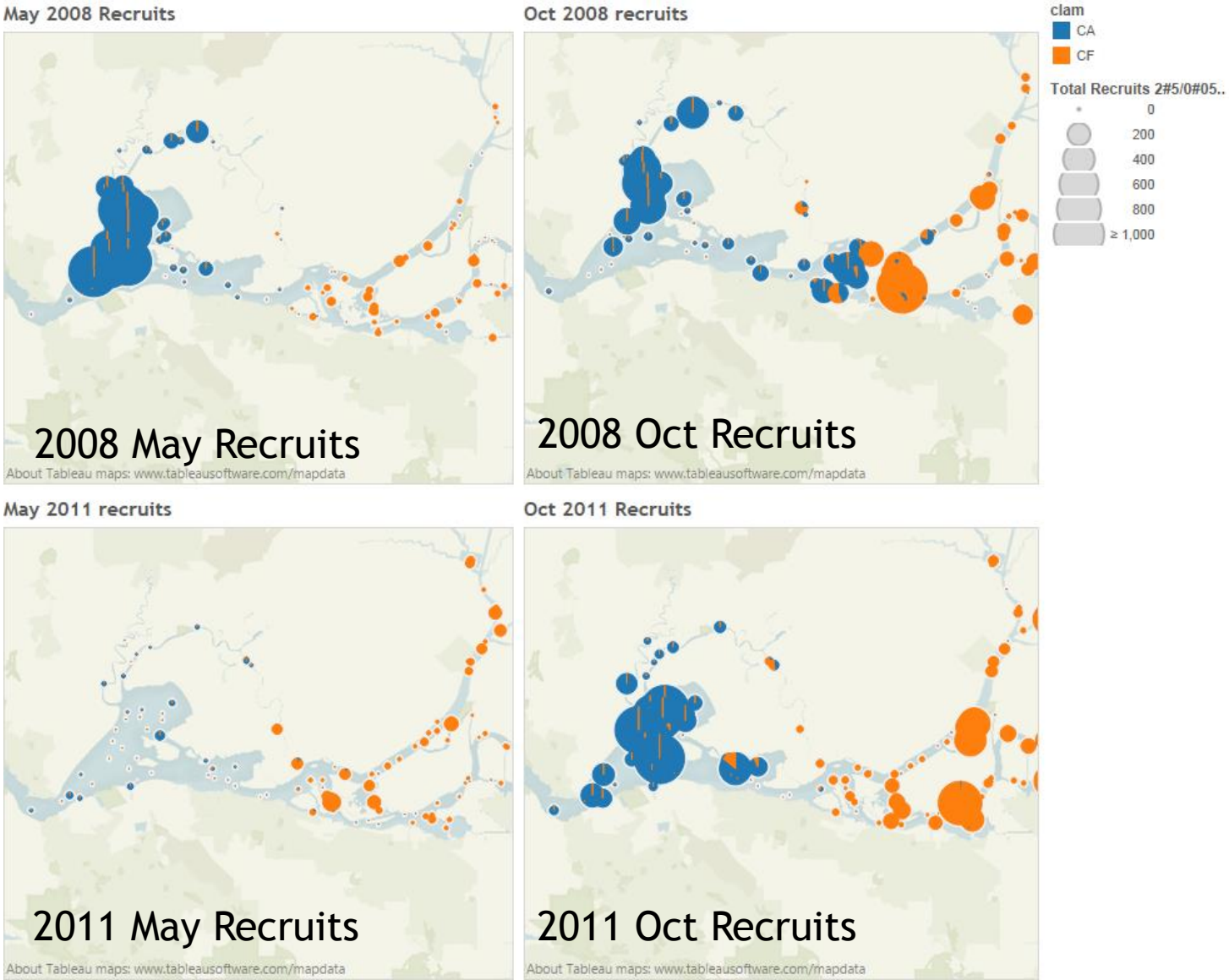


Observation #2: Relative strength of grazing turnover rate is in seasonal opposition between the bivalves

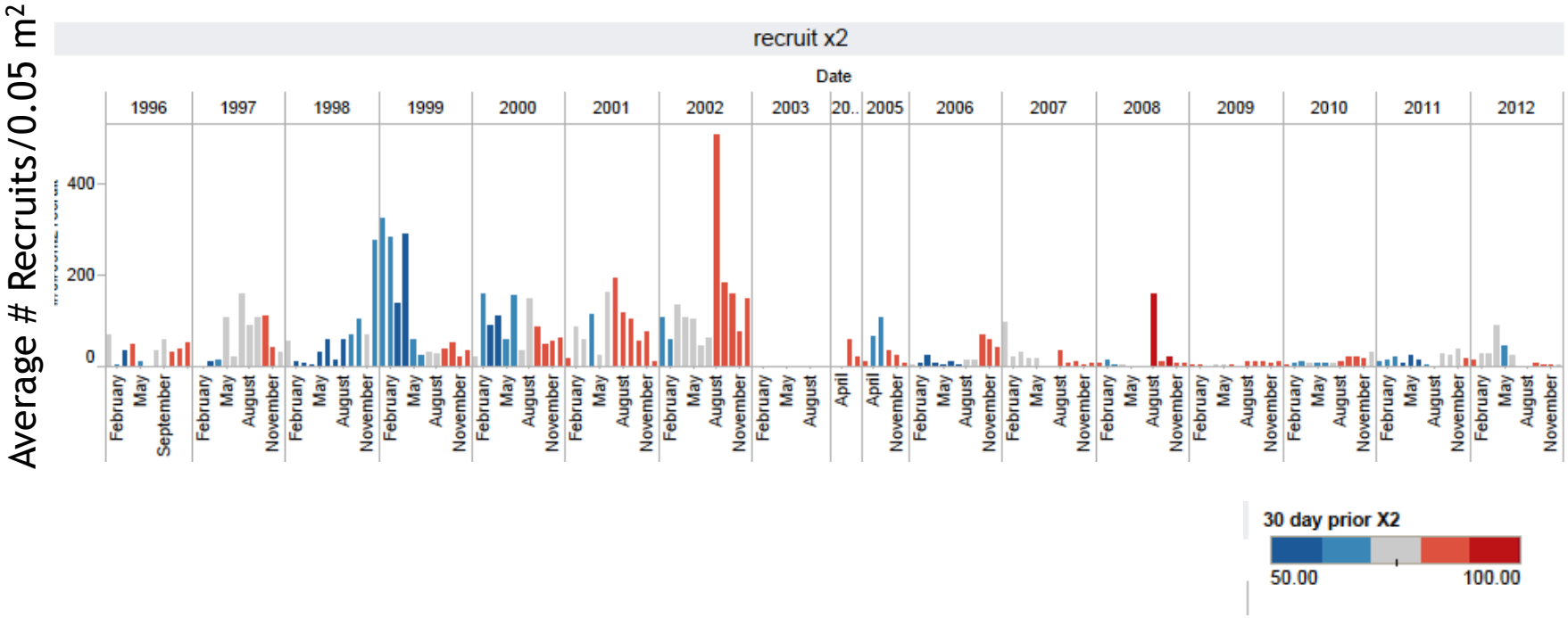


Dry year after a dry year

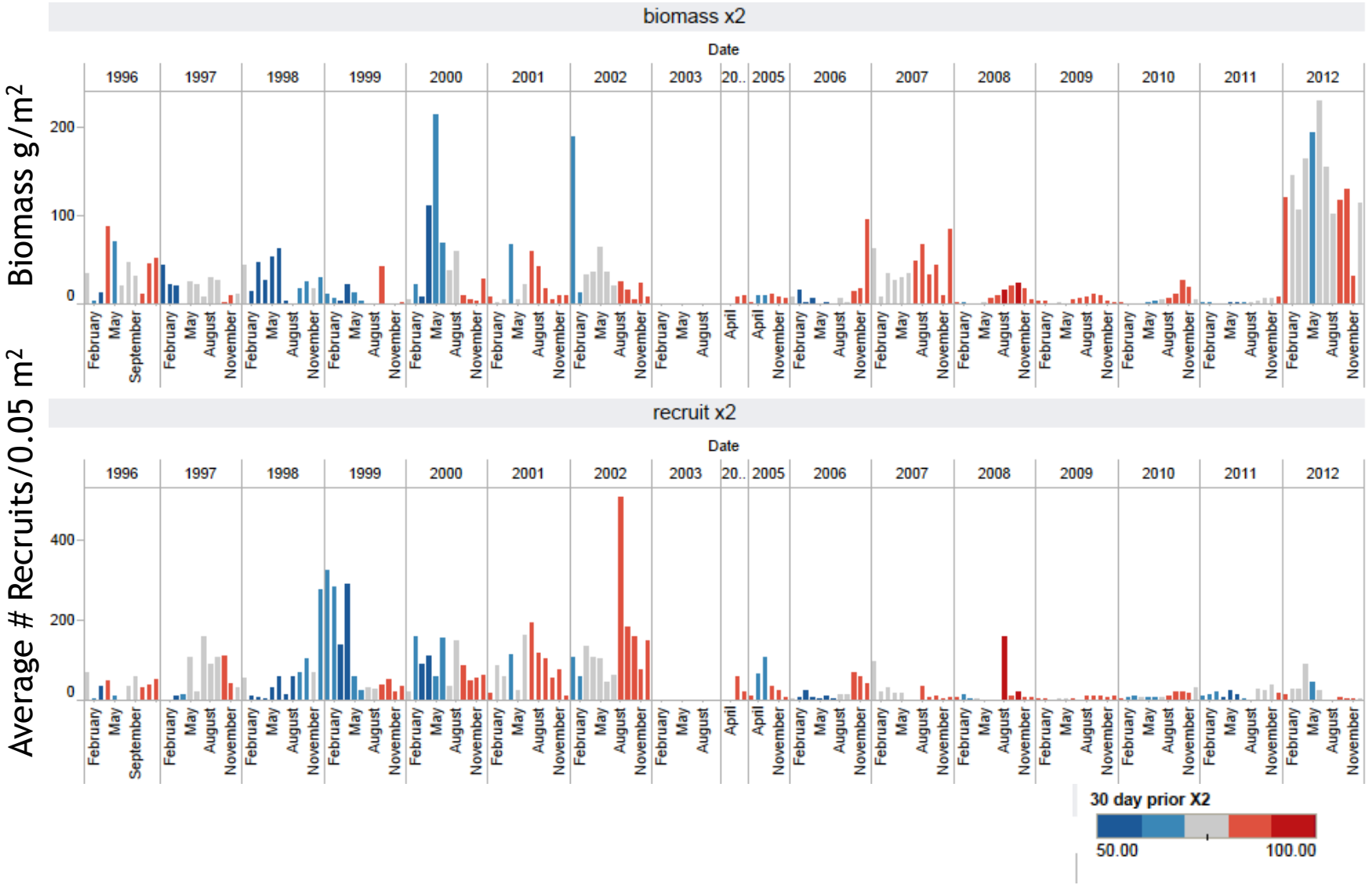
Not a Mechanism #1: Recruitment cycles may contribute but do not control the pattern. Freshwater inhibits *Potamocorbula* recruitment in spring in wet years and limits the spatial extent of recruitment in dry years. Fall recruitment is always present. *Corbicula* recruits more in fall of both years.



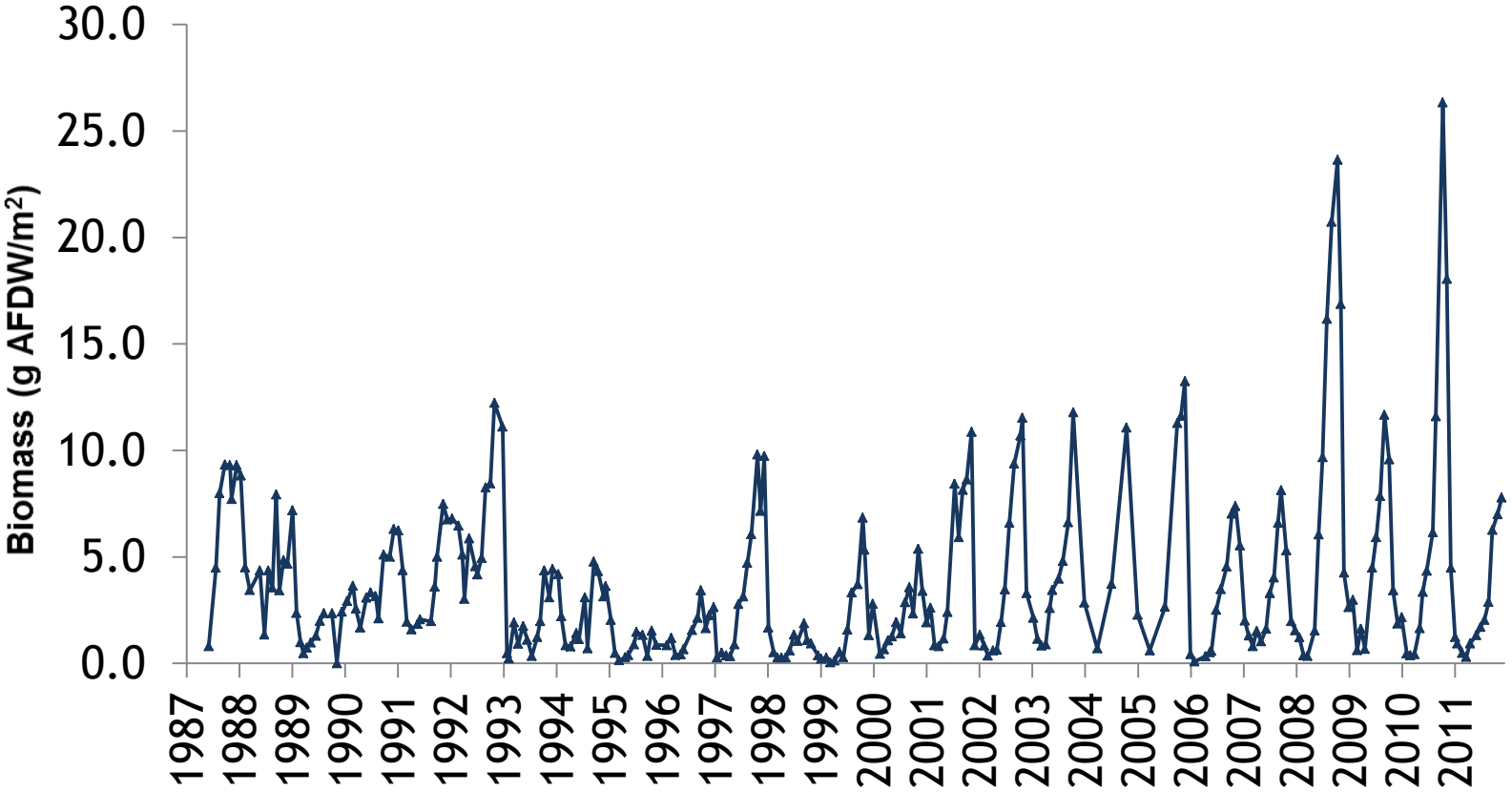
Recruitment is not the mechanism #2: Monthly data in the Sacramento River shows us that *Corbicula* can recruit all year in all types of water years, that recruitment usually peaks in fall, and something changed in 2005.



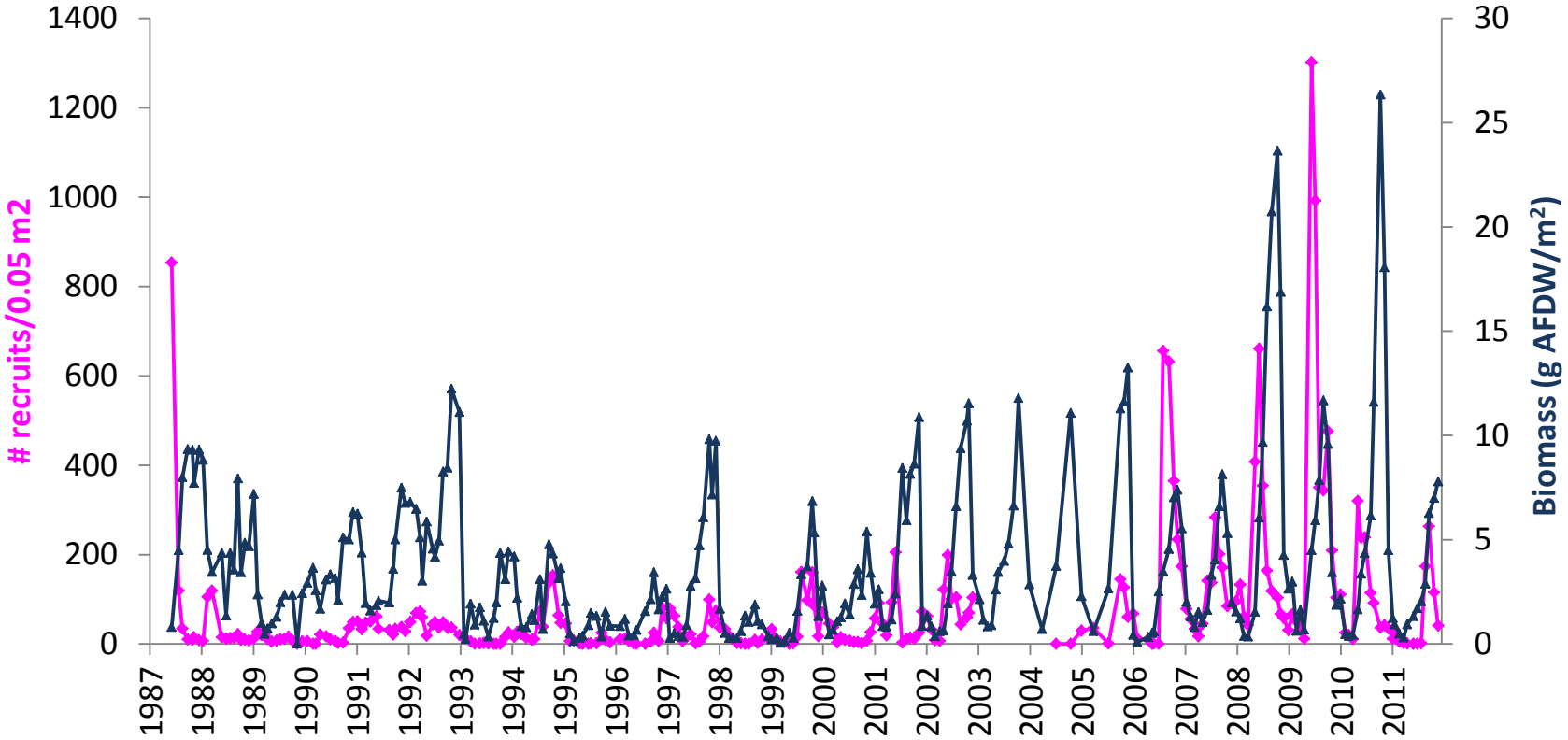
Effect: Why is lack of *Corbicula* some recruitment control important? Because biomass did not show a similar decrease after 2005. There are enough recruits to maintain a high biomass of *Corbicula*.



Mechanism:To understand recruitment in *Potamocorbula* we need to understand the biomass cycle. The minimum biomass in winter in shallow water populations is most likely due to predation. Population biomass peaks in fall.



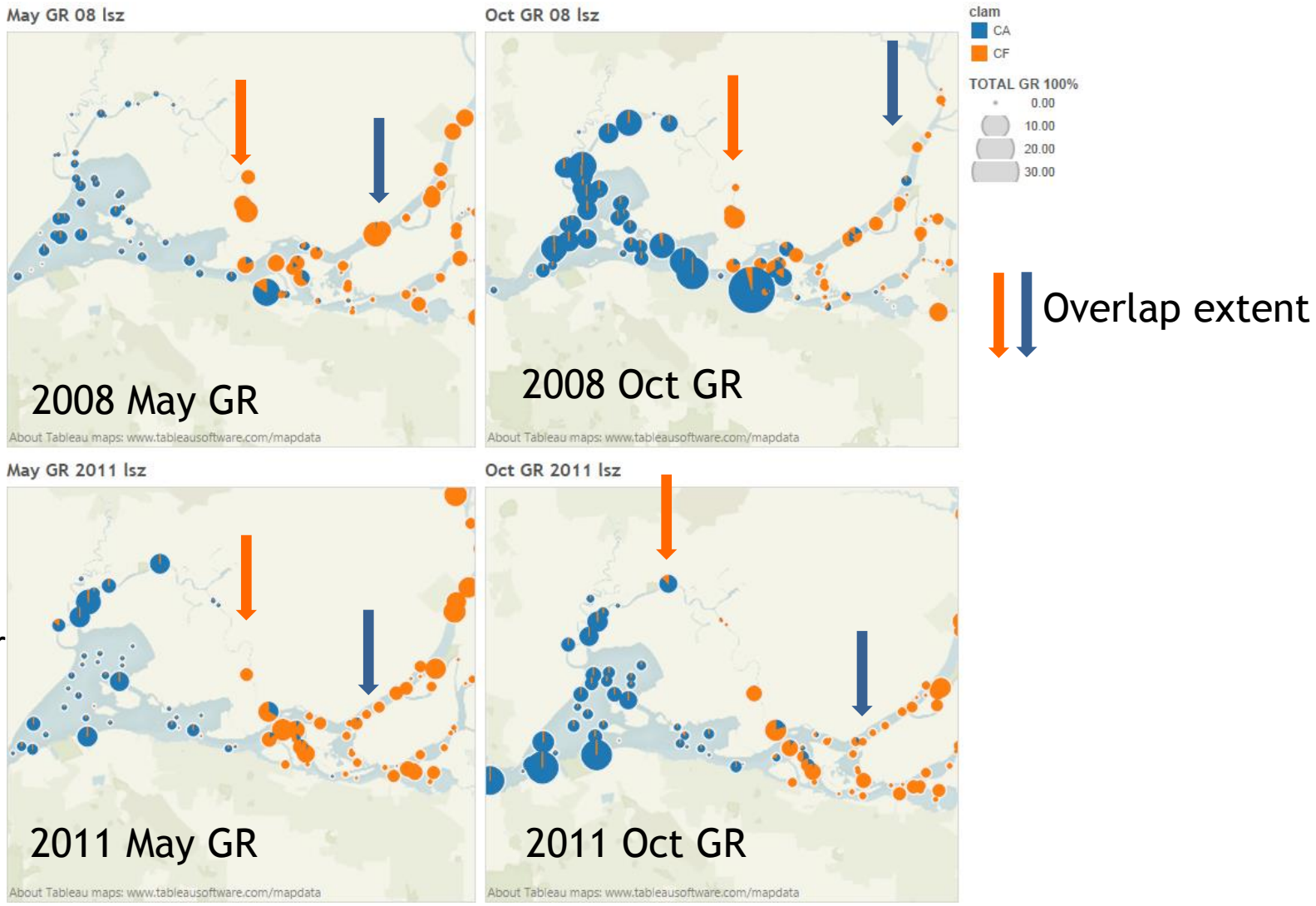
Effect: Although the biomass peak follows the recruitment period, the recruit abundance does not appear to be related to biomass magnitude in *Potamocorbula*. These are patterns we expect in opportunistic animals that are limited by some resource – I suggest food.



Observation #3: The species overlap around X2 in the LSZ. There is downstream movement of the fall overlap zone in wet years when compared to dry years. The spring overlap location changes little between dry and wet springs.

Dry after Dry year

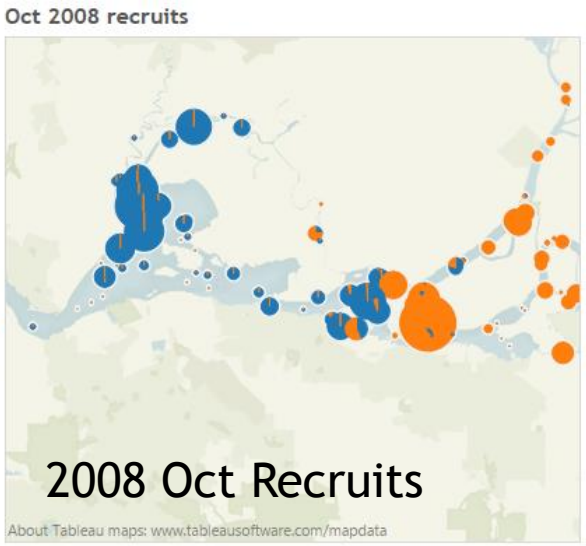
Wet after Normal year

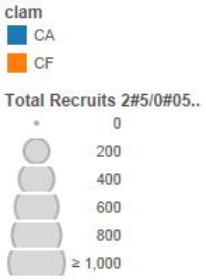


DWR IEP/EMP Samples; USGS processed

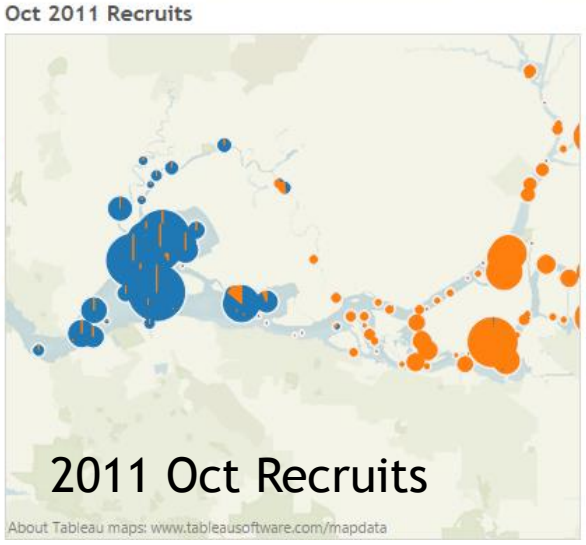
Mechanism - These distribution ranges are mostly driven by recruit distribution within the X2 region. *Potamocorbula* upstream migration is limited to fall but *Corbicula* move downstream in both spring and fall – why doesn't it go further downstream in spring?

Dry after Dry year





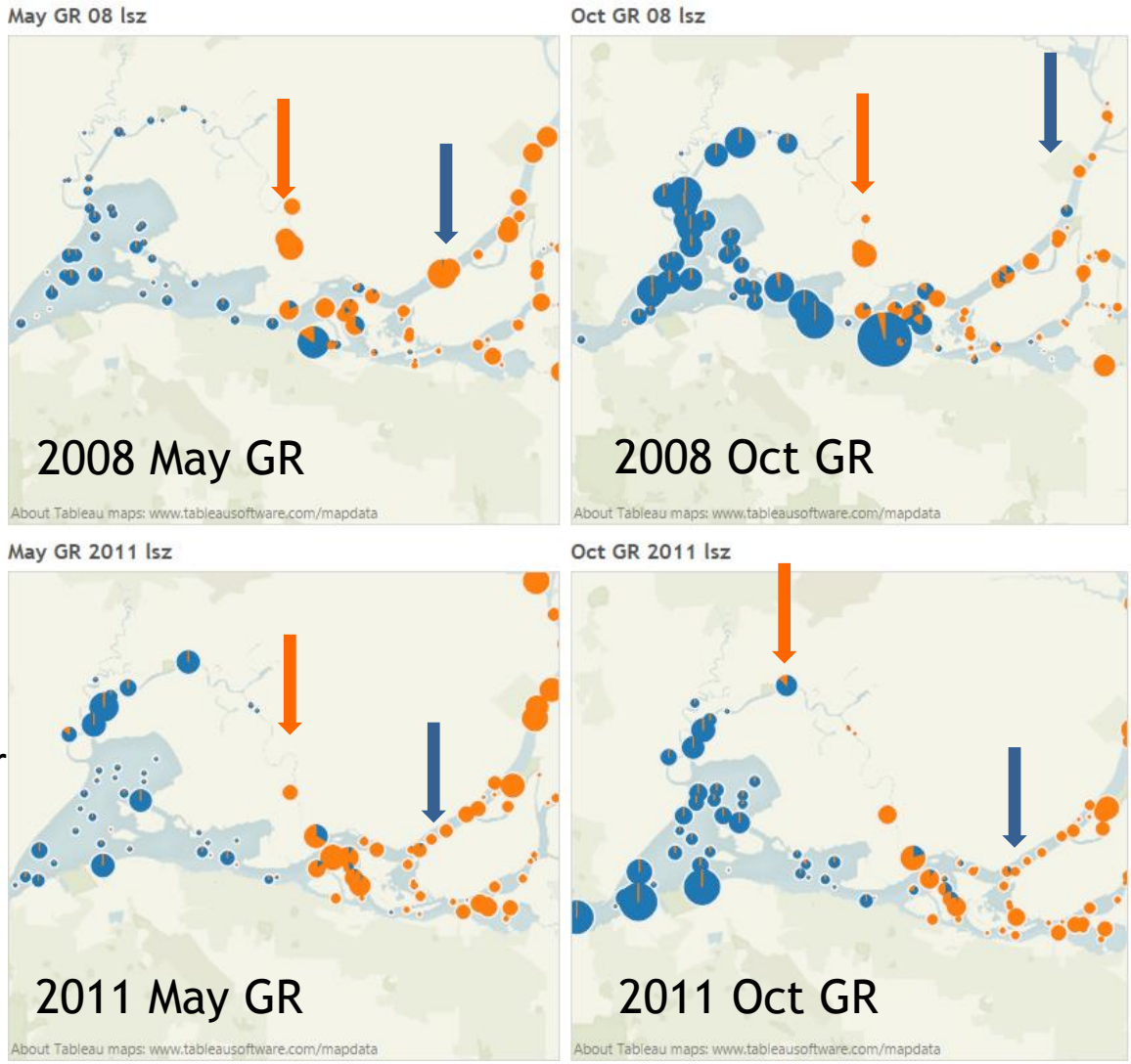
Wet after Normal year



Effect: There is little difference in *Potamocorbula* grazing rate in wet and dry springs. The smallest grazing impact on the LSZ occurs in wet falls when *Potamocorbula* are pushed downstream.

Dry after Dry year

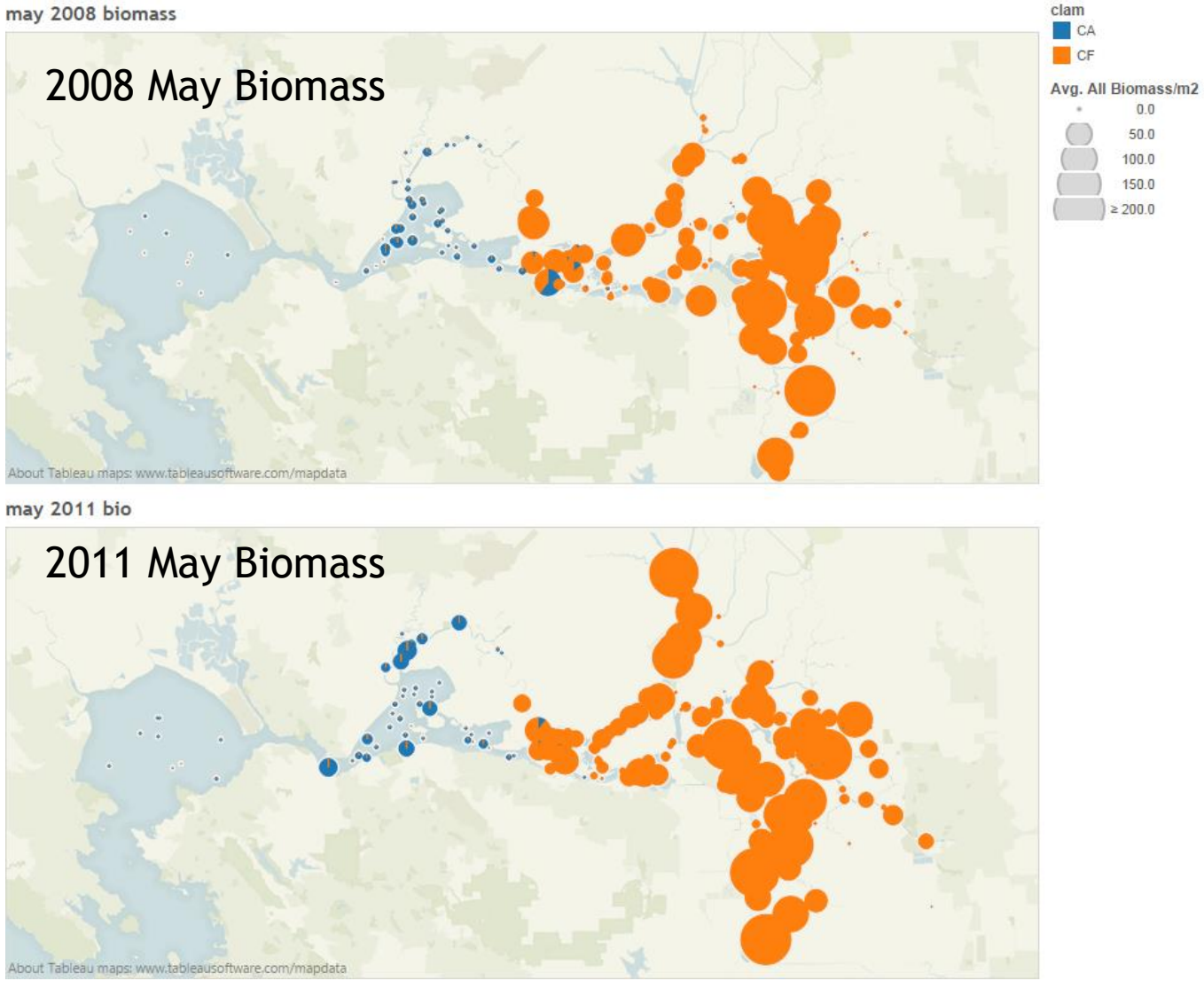
Wet after Normal year



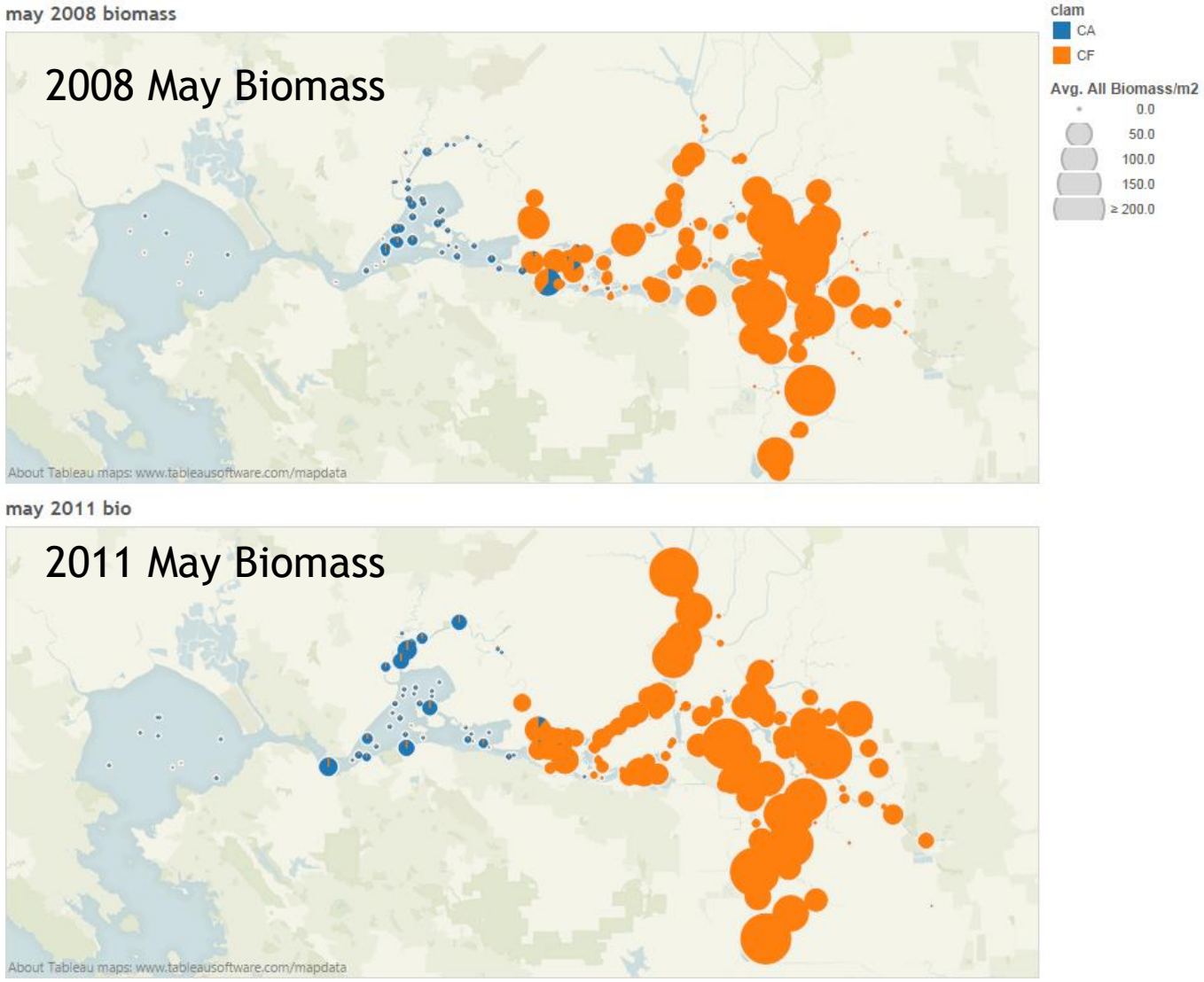
Overlap extent

DWR IEP/EMP Samples; USGS processed

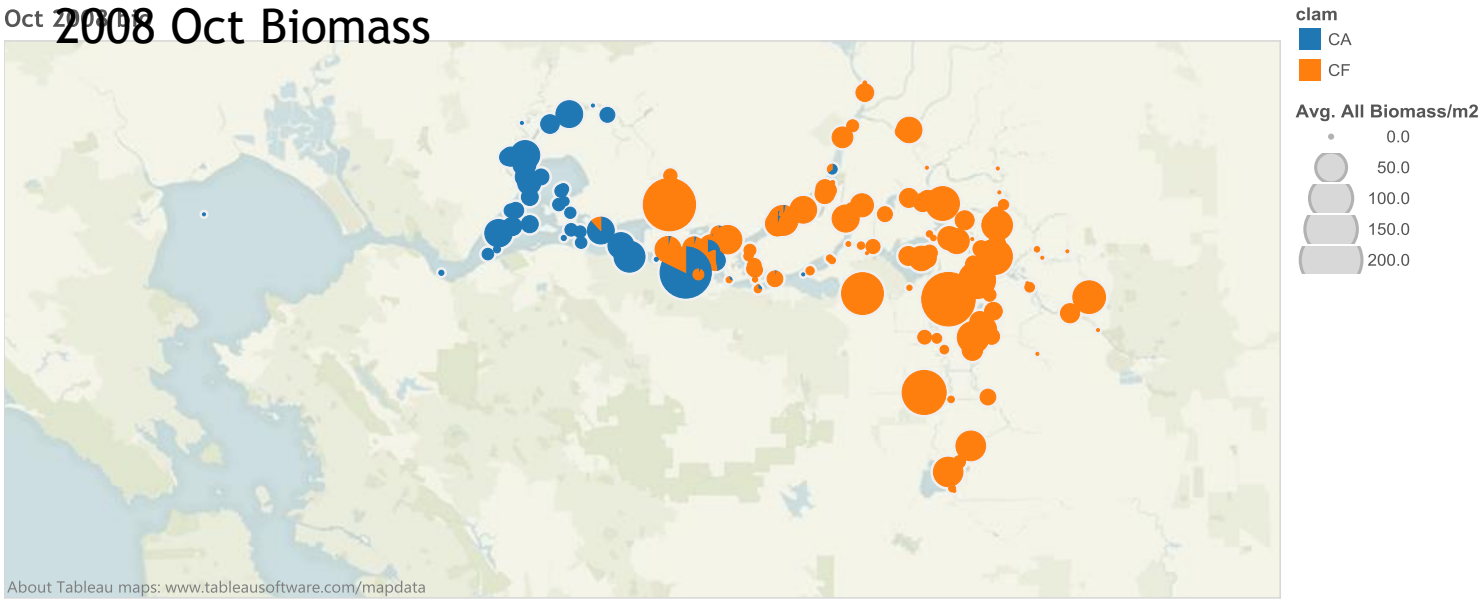
Observation#4: Full system FLASH effects. *Corbicula* biomass had a wider distribution of high biomass in spring of the wet year than the dry year.

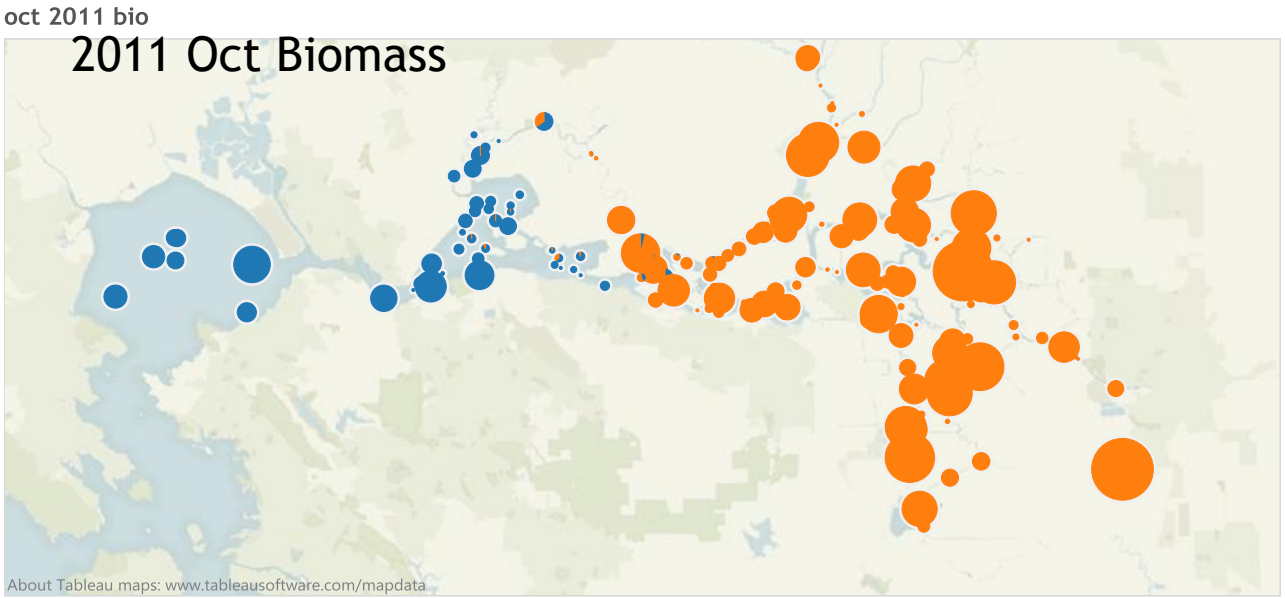


Mechanism: Watershed production of food in wet springs?

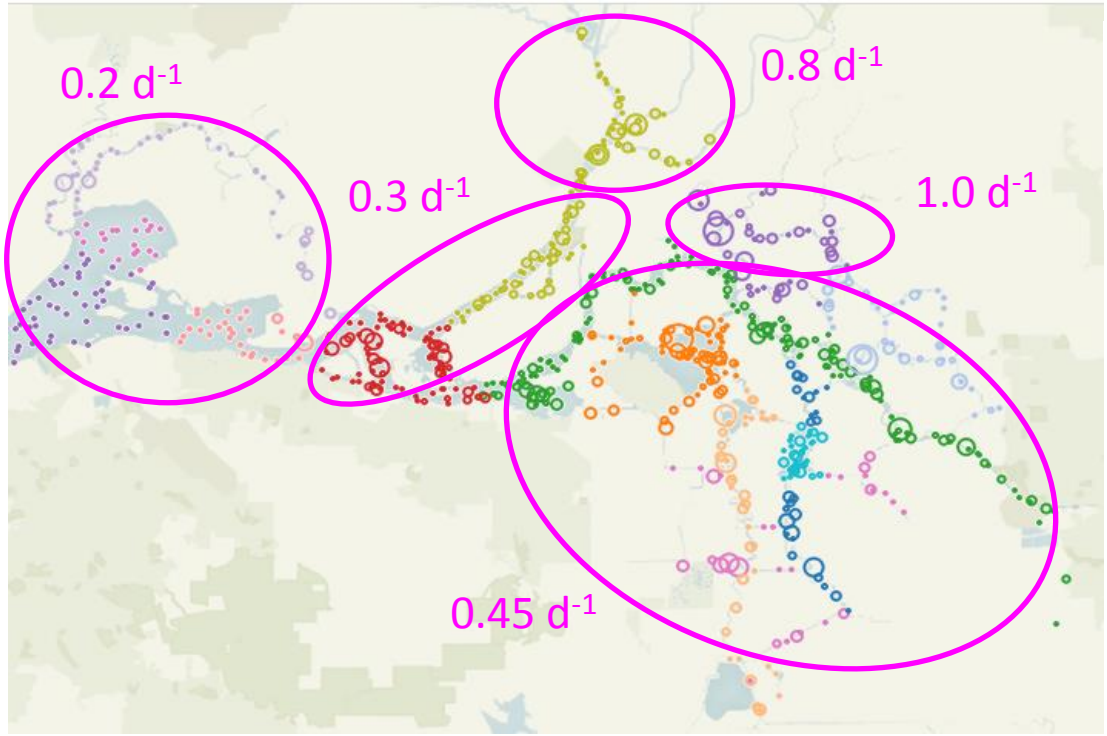


FLASH Effects: Lower LSZ *Potamocorbula* biomass in FLASH fall but there was higher *Corbicula* biomass in rivers?

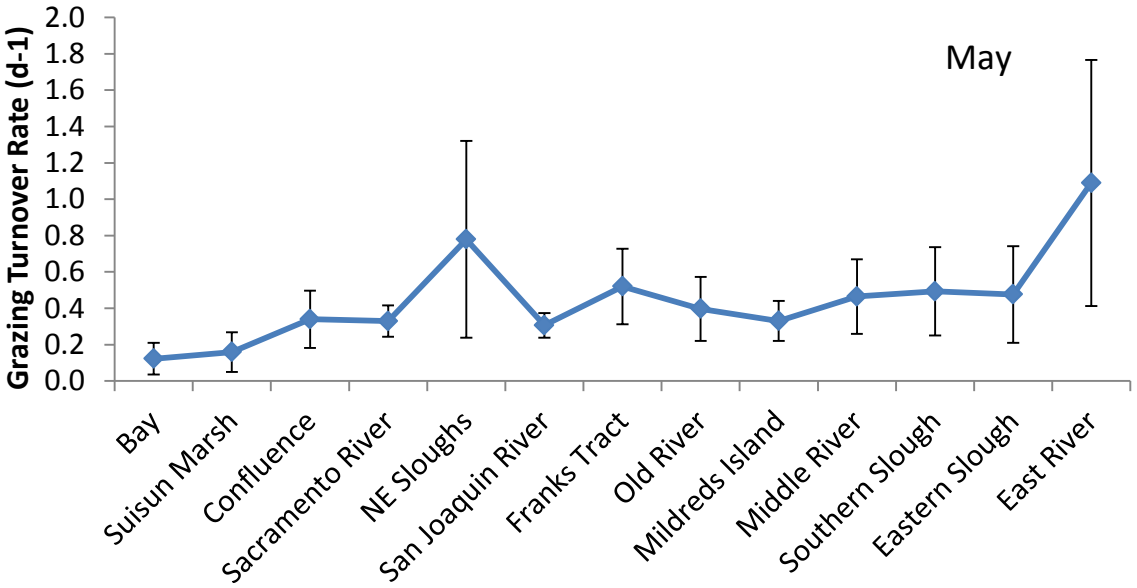


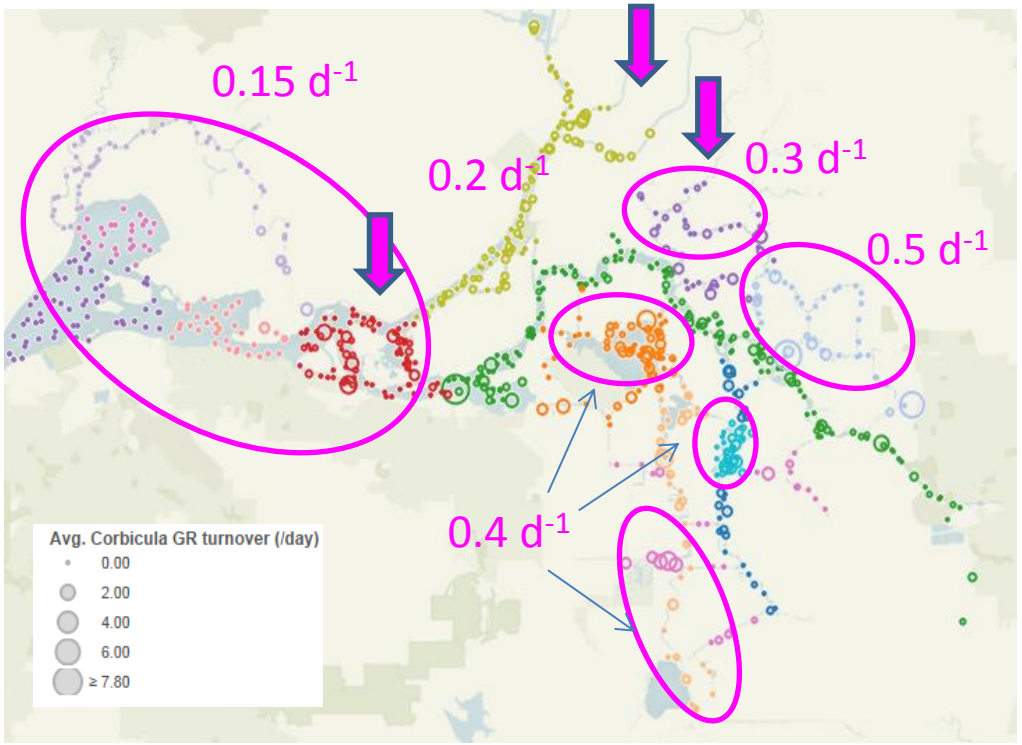


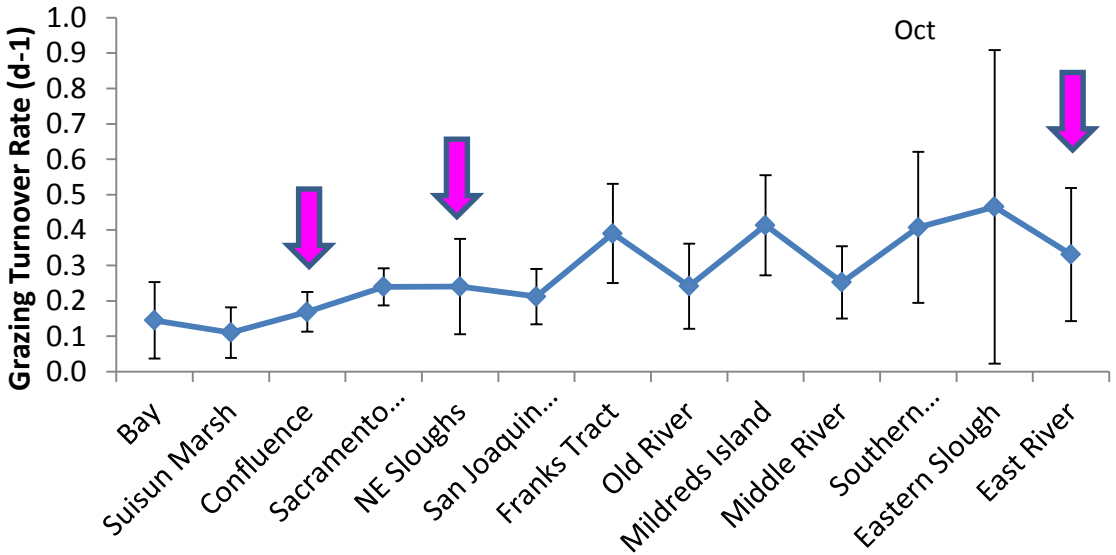
Sorting it out – numbers in spite Jason Pollack effect.



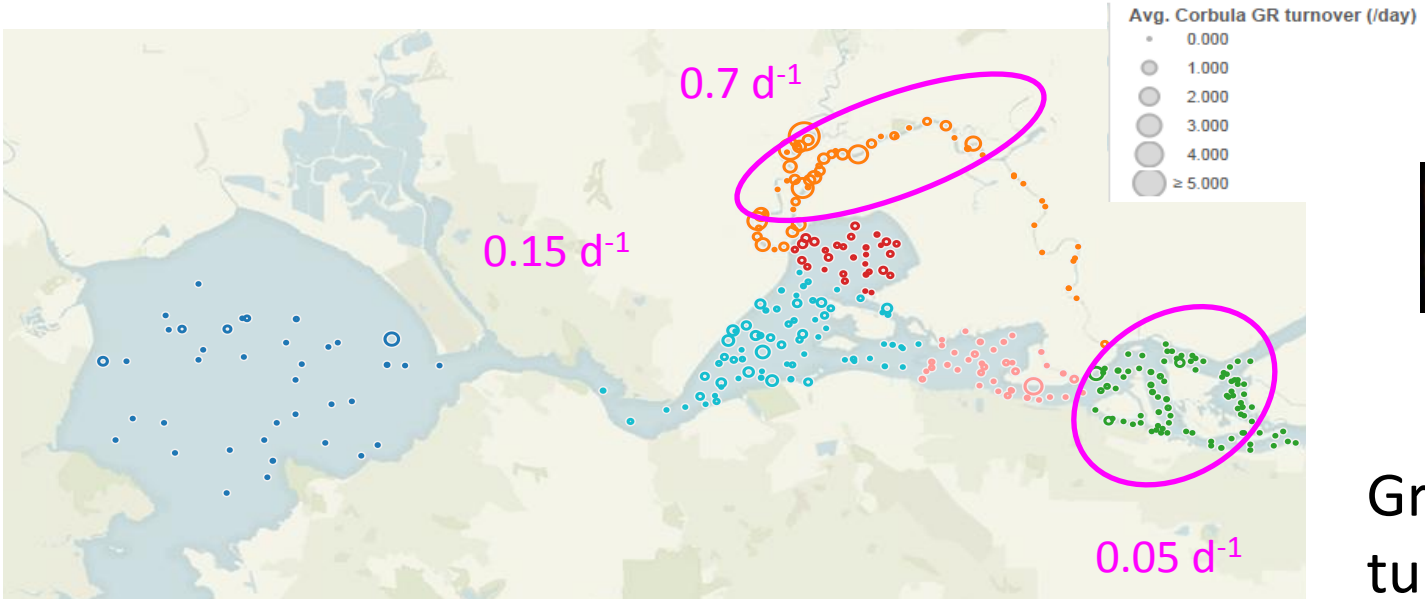
Grazing turnover rate by *Corbicula* ranged from <u>0.1 to 1/day</u> in May (2007-2012)

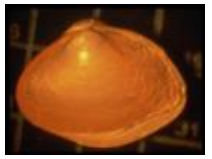


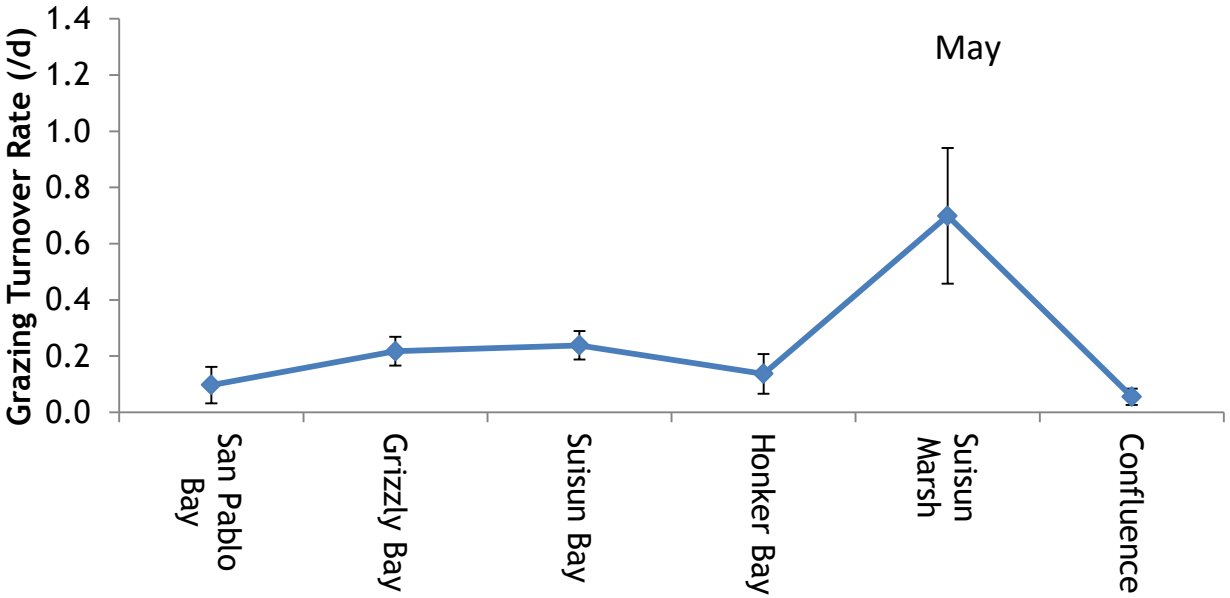




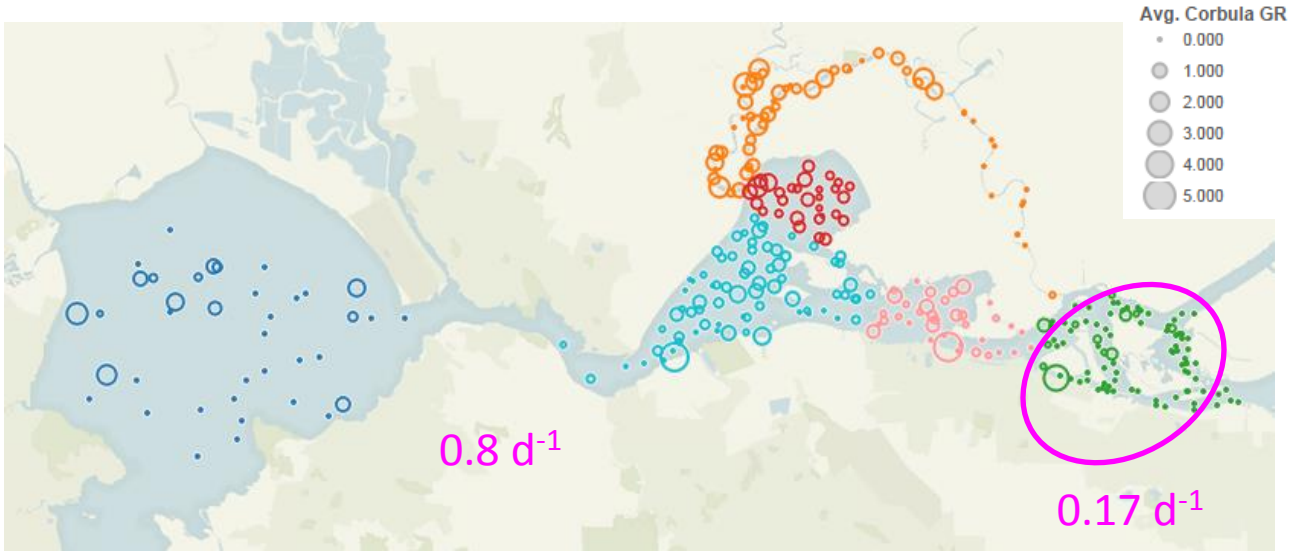
Corbicula grazing turnover rate in October was similar to May (2007-2012) except at ↓ where it was 50% lower.

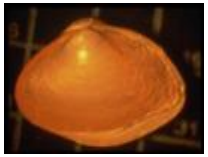


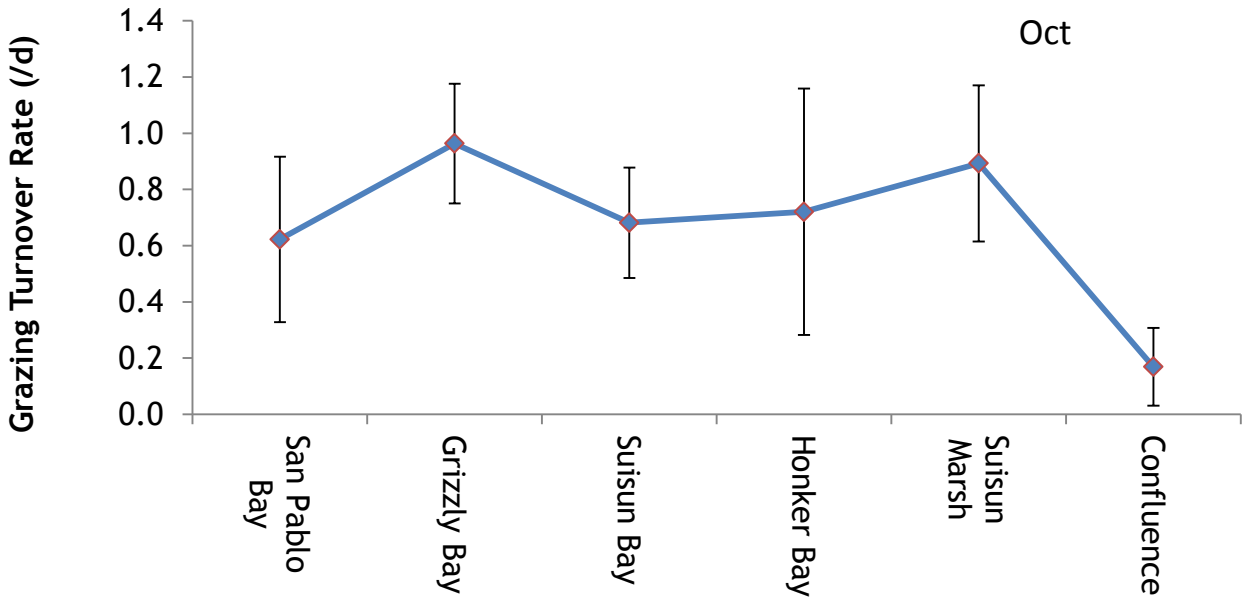




Grazing turnover rate by *Potamocorbula* ranged from <u>0.05 to 0.7/day</u> in May (2007-2012).



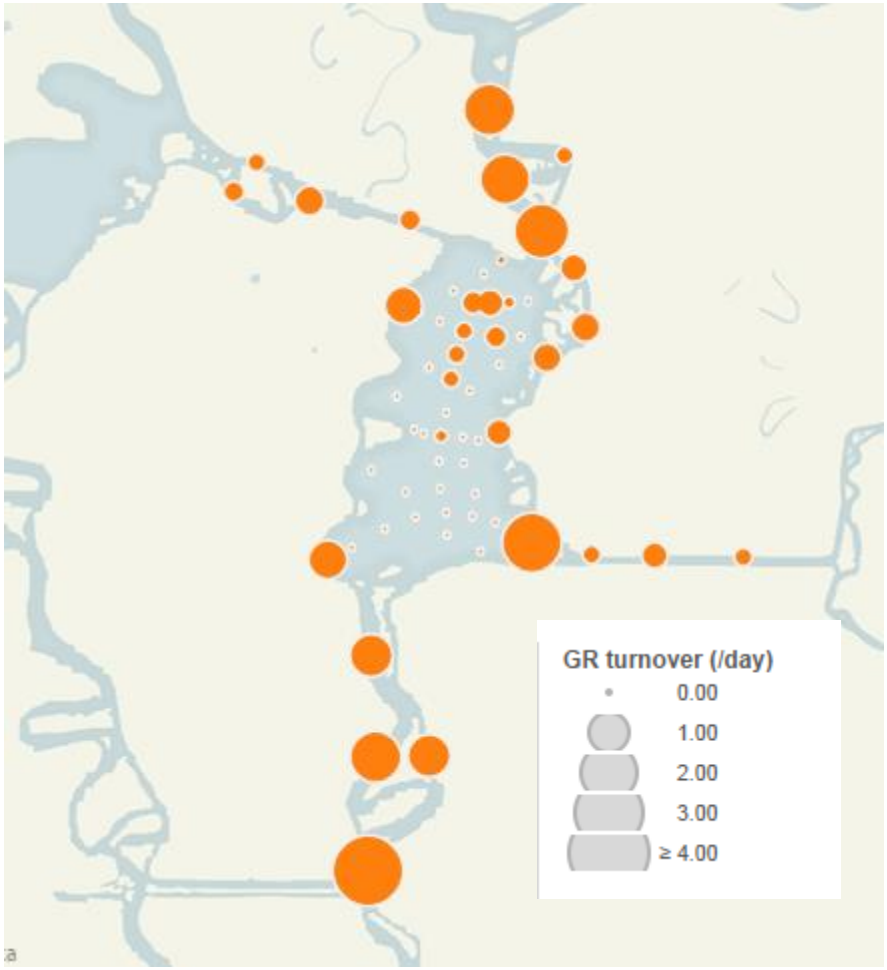




Grazing turnover rate by *Potamocorbula* were 5X higher in October than in May (2007-2012).

Mechanism: Watershed production of food in wet years?

A final restoration concern – everything is connected. If you produce food in the lake the clams will "cover" the exits.

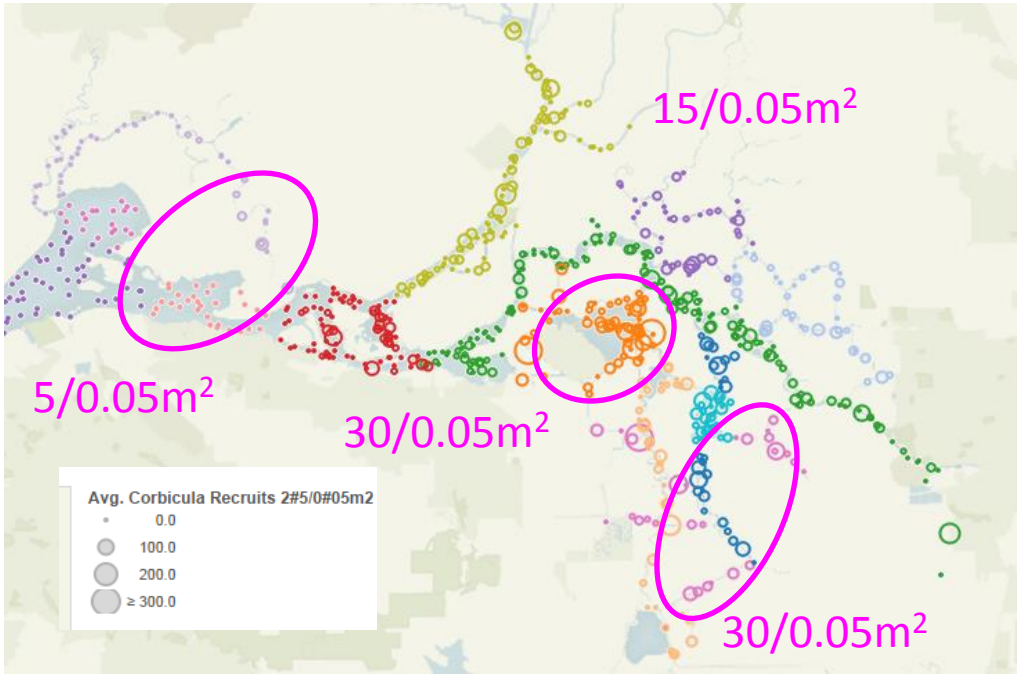


Restoration Concerns

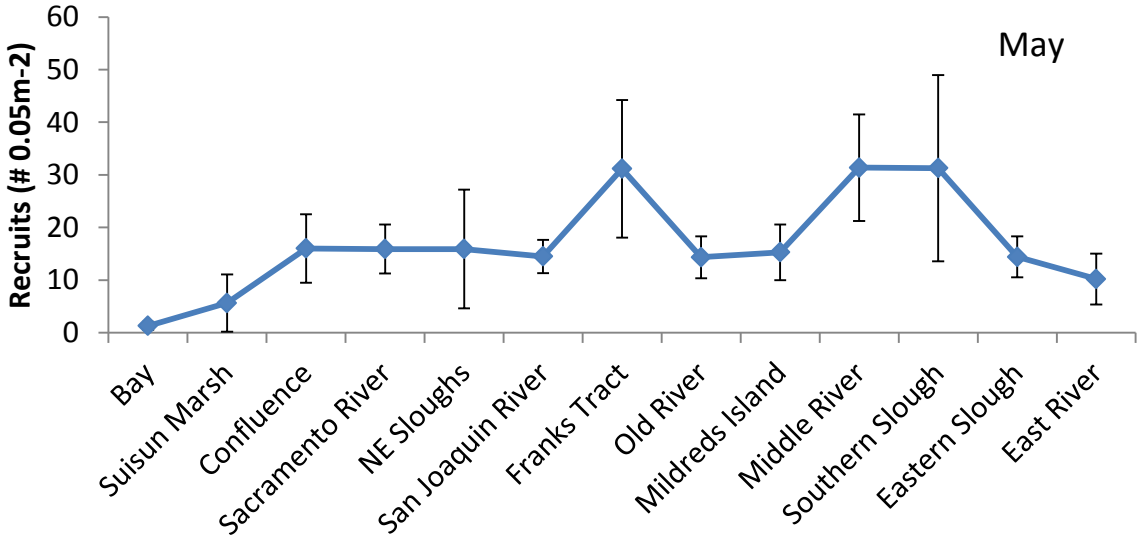
- ✓ *Corbicula* recruits are always available
- ✓ *Potamocorbula* recruits are available most of the year in dry years but are seasonally limited in wet years
- ✓ Both species appear to be food limited and respond fast to change in resources.

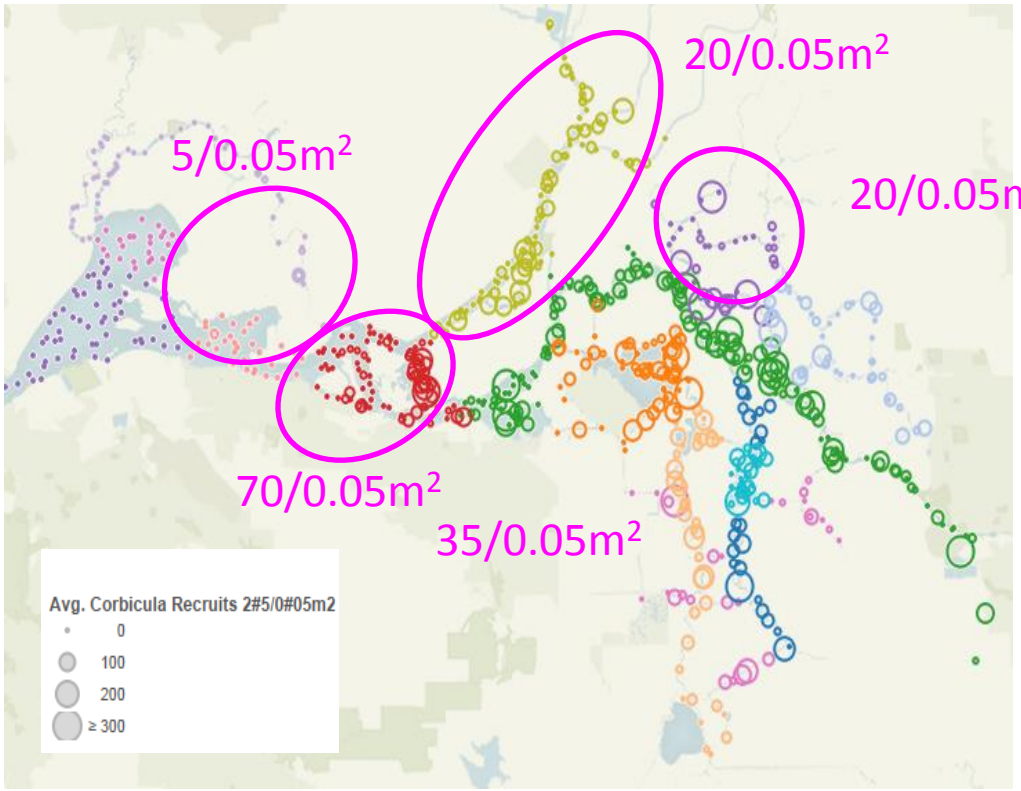
Research Needs

- ✓ Where and when do *Corbicula* invade places like Cache Slough, Liberty Island.
- ✓ More benthic grazing estimates with coincident phytoplankton biomass and appropriate parameters.
- ✓ Genetics of both species - who are these guys?
- ✓ How productive are the *Egeria* beds.
- ✓ What is the relative importance of amphipods as fish food and where are they produced?

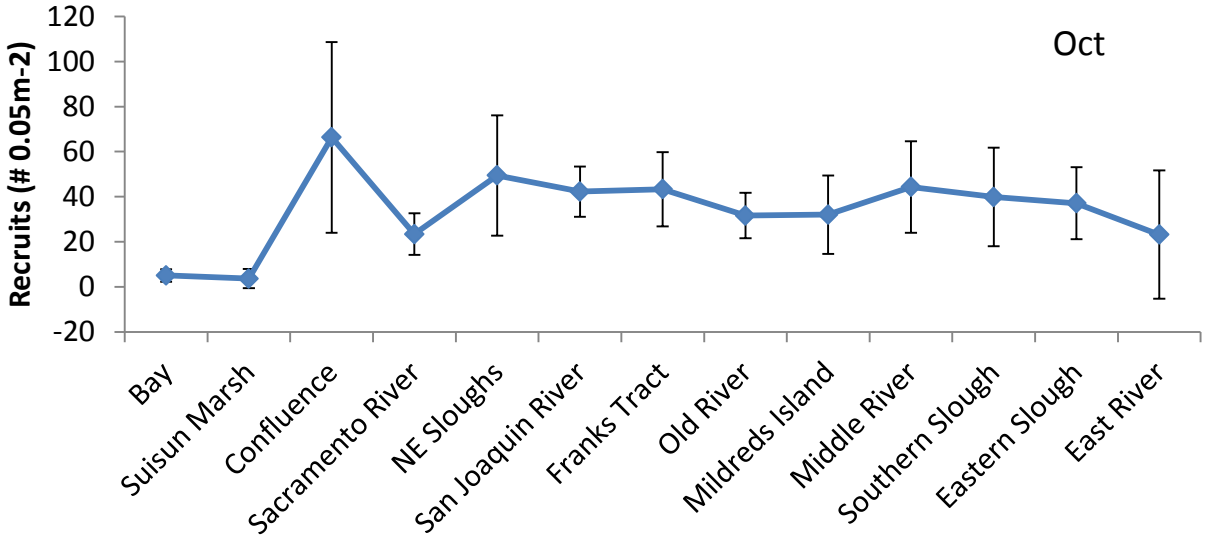


Abundance of Corbicula recruits in May (2007-2012) was uniform except for two "hot spots"

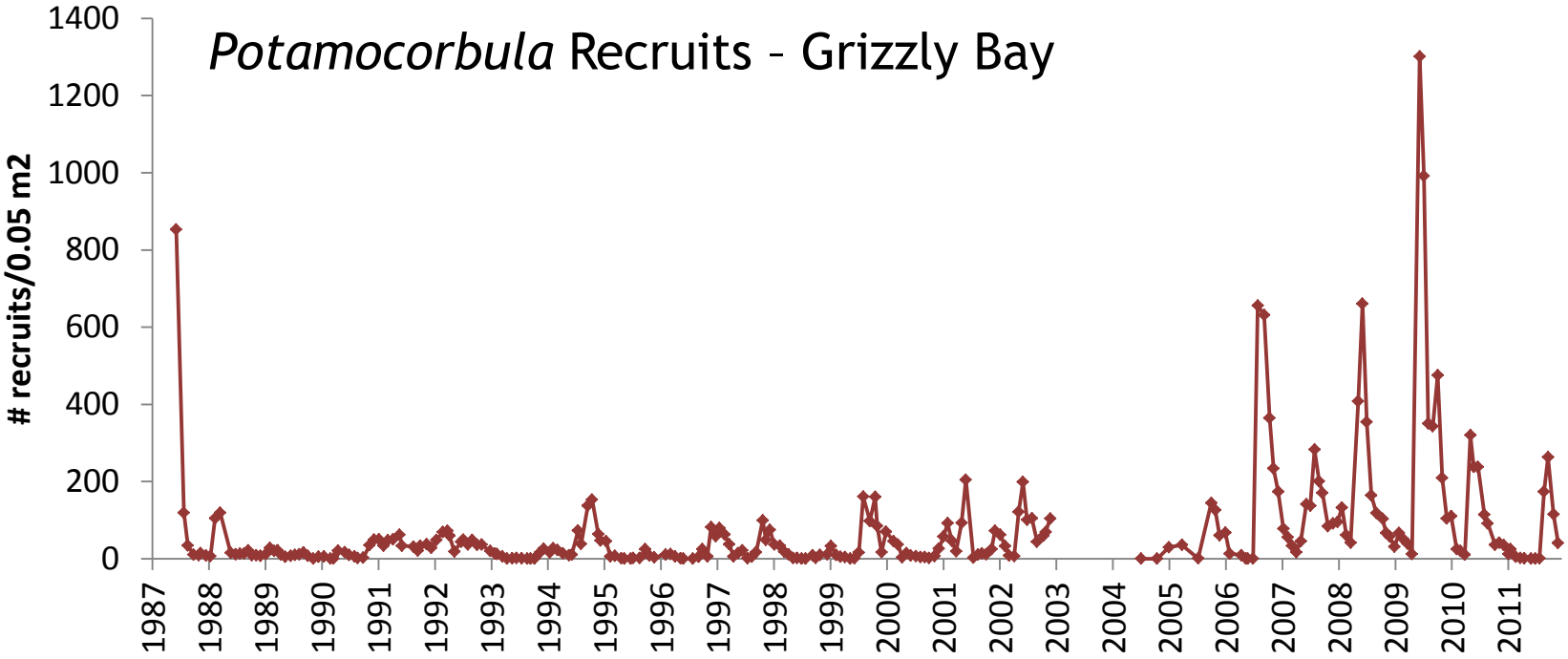




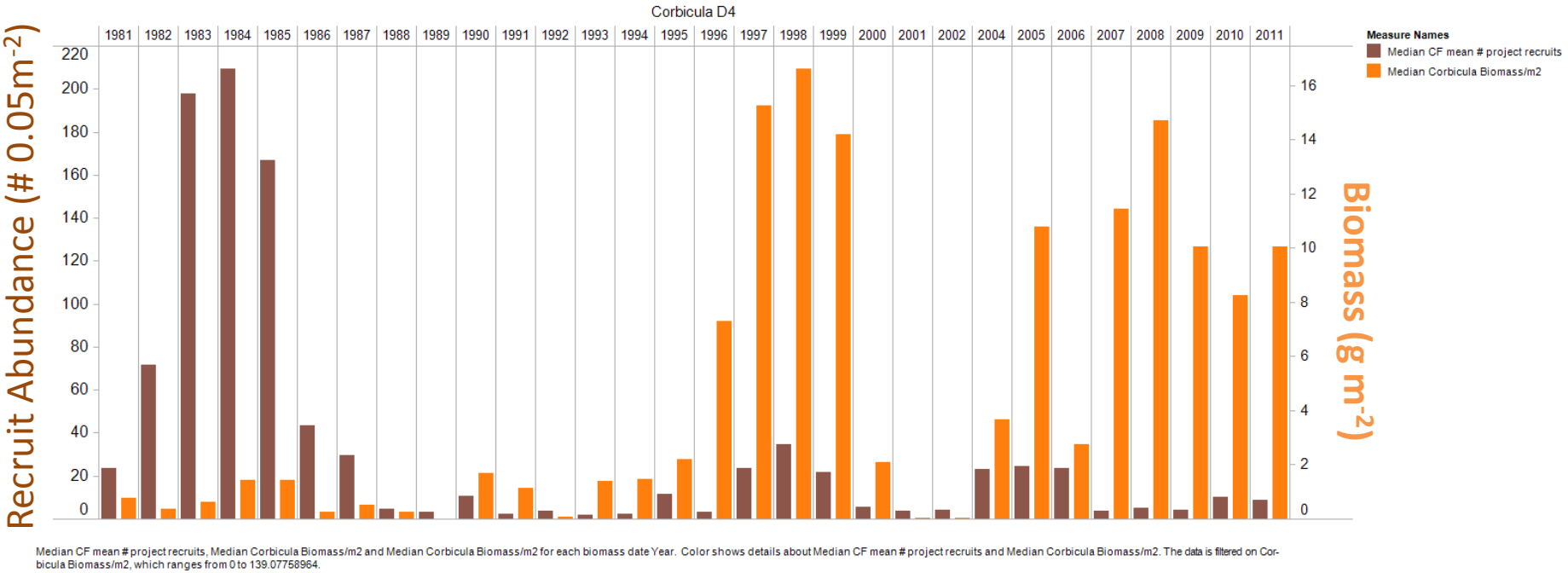
Abundance of Corbicula recruits was higher in October than in May (2007-2012). About twice the number in most locations



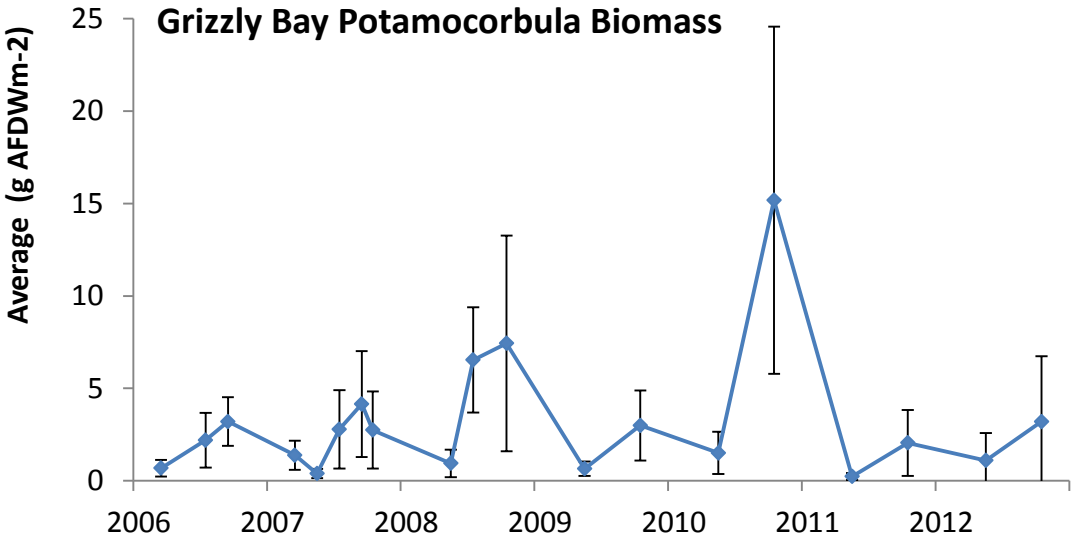
Mystery 1 – What happened after 2005?

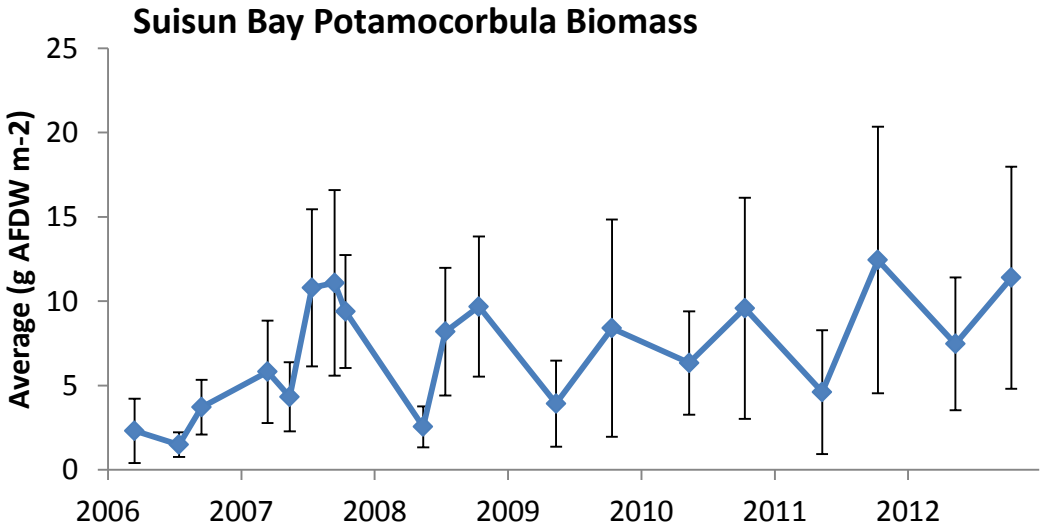


Mystery 2 - What happened after 1987? *Potamocorbula* – really?



Corbicula Recruits and Biomass – Collinsville





It is possible to use a bit more statistical rigor with *Potamocorbula* which has a repeating seasonal cycle.